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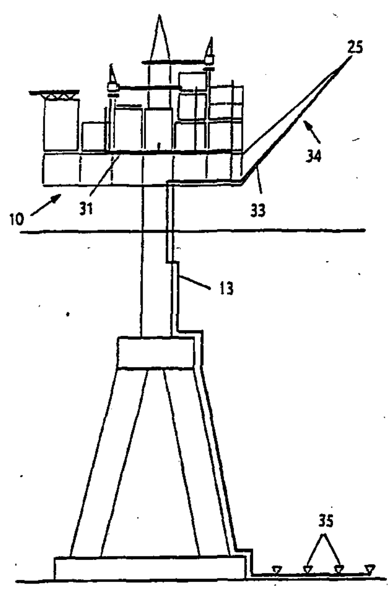

(57) Abstract

Method for depressurization of a production process on a platform (10) offshore where gas, in the case of depressurization of the production process, wholly or partly is led to discharge under water, and a device for a pressure-relief system.

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Devide for a pressure-relief system for processing equipment on offshore platforms.

TECHNICAL FIELD

The present invention relates to a method for pressure relief in a production process on a platform offshore. The invention also comprises a device for a pressure-relief system.

BACKGROUND ART

Production plants for oil/gas are always provided with gas-relief systems in order to relieve the pressure in production processes. Depressurization can be necessary for production or safety reasons and in such situations the gas must be directed to a safe area in the space of a short time. According to current conventional system, the gas is directed through a header system to a flare for burning off. Due to the large quantities of gas which have to be drained in a short space of time, the heat radiation from the flare will be a limiting factor which determines the shortest distance between flare and platform. For example, it can be mentioned that the longest flare-boom installed in the Norwegian sector of the North Sea is 137 metres. Long flare-booms cause a heavy load on the module support frame and induce a negative displacement of the platform's centre of gravity. As production moves towards increasingly greater depths of water, it will be of crucial importance to be able to keep the weight on the platform deck at a lowest possible level. New areas which are currently being planned for development will achieve considerably greater production levels, particularly of gas. The amount of gas to be depressurized within a defined period of time will therefore be substantially greater than in previously known constructions offshore.

The authorities in most countries which participate in oil production offshore have regulations which demand that all processing equipment can be pressure-relieved within a definite period of time. In areas of extensive production, particularly of gas, in a conventional system, a very long flare-boom will be required

and this will entail considerable constructional problems. An alternative which is suggested, is to divide the platform into several zones, where each zone is fire and explosion-proof in relation to the other zones. In the case of fire, explosion or other risk situations, it is suggested that only each zone will have to be pressure-relieved within the time-limits set by the authorities. In order to achieve a sufficient degree of security with such a system, fire and explosion-proof walls between each zone are obviously necessary, and this will be expensive. In the case of any leakage of gas, it must be certain that no gas can travel from one zone to another, and this makes great demands on the constructional design. Moreover, a zone-divided pressure-relief will require a much more complicated pressure-relief system. The method of zone-divided pressure relief can therefore be considered a far from satisfactory solution, both economically but perhaps even more security-wise, since the total time of depressurization will be considerably extended.

The objective of the present invention is to achieve a method of depressurization of a production process on a platform offshore, where the need for a conventional flare is eliminated or where the length of the flare boom can be considerably reduced, and where the total length of time of depressurization can be kept as short as possible.

DISCLOSURE OF THE INVENTION

According to the invention, this is achieved by a method which is characterized in that the pressure-relief medium, mainly gas, is fully or partly led to release underwater. The invention also comprises a device for putting the method into practice.

The new concept for depressurization of production processes on platforms offshore represents a considerable progress compared to already known, conventional concepts where all depressurization is carried out through a flare. The concept will be particularly

advantageous on platforms with high production and therefore large amounts of gas to be relieved of pressure, and where the dimensions of the flare boom can be dangerously large in a conventional pressure-relief system. According to a preferred embodiment of the invention, sources of high pressure in the production process are relieved of pressure by way of the underwater gas-release system, to a level of pressure similar to the static pressure at the point or points of release. Gas with a pressure below this level is relieved by way of a conventional flare. Calculations which have been carried out show that, typically, a quota of between 50-70 % equivalent volume units of the gas to be released, will be able to be pressure relieved underwater. This will of course have a considerable, positive influence on the size of the flare-boom.

The invention will also be of great importance on floating production platforms, where the size of the flare boom plays a critical role in the stability of the platform.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in more detail in the following with reference to the accompanying drawings where,

fig. 1 shows a basic embodiment of the invention,
fig. 2a-2c show schematic embodiments of the pressure-relief concept according to the invention,
fig. 3 shows an embodiment of the invention,
fig. 4 a-e show various embodiments with gas-release at various depths.

MODES FOR CARRYING OUT THE INVENTION

In fig. 1 a fixed platform 10 is shown, with an indicated underwater gas-release system 13, indicated in the form of a pipe, and where the gas is released under water at a considerable depth

beneath the surface of the sea 12. Tests have shown that a discharge of gas at a depth of 100 metres, will spread on the surface over an area greater than 100 m^2, and if the depth is increased to 200 metres the area becomes 4 times as large. The reason for the size of the area is the heavy spreading which takes place in the plume of bubbles under water. Even with large amounts of gas, concentration on the surface will be small as long as the water depth is sufficiently great. For fire to occur, a minimum concentration of 4-5 % (for natural gas) is required, a condition which seldom arises. It is therefore possible to release gas in deep water, as an alternative to burning-off, without any danger or other disadvantages occurring.

By replacing a traditional flare boom with a system of gas-release under water, considerable reductions in weight on the platform deck will be achieved and thus far better stability for the platform, since the centre of gravity of the platform can be lowered. A pressure relieval system which discharges gas in deep water will however, have an internal system pressure, which is at least as great as the static pressure at the depth of discharge. This means that such a system alone will not be able to depressurize for instance, process equipment down to, for instance, atmospheric pressure, something which in some cases will be necessary.

In a preferred embodiment the gas-release system consists therefore of a combination which comprises a conventional pressure-relief system with a flare and a gas-release system under water. With such a "double-release system" the flare can be dimensioned to receive considerably smaller amounts of gas, and can therefore be built shorter and with a much lower weight. In the case of constructions in deep water and where it will periodically be necessary to release large amounts of gas, such a system will be particularly advantageous, since it will be possible to build the platform deck smaller and cheaper. A schematic embodiment of such a "double release system" is illustrated more closely in fig. 2a

which shows a gas-release system according to the invention where gas from sources of high pressure is led by way of a high-pressure tank 21 and a high-pressure line 22 to discharge under water. The high-pressure line 22 comprises a branch or side-line 24 a which leads gas to a conventional flare 25. The gas flow in the side-line 24 a is limited by a choke 23 a. Gas with low pressure, is led by way of a low-pressure tank 26 and a separate line 27 to the flare 25. In the figure, a separate loop 28 to lead off gas with atmospheric pressure is also indicated. Figure 2b indicates schematically an alternative embodiment of a double depressurization system where high-pressure gas, for example from underwater sources, is led through a header line 22 to release under water. Instead of a separate side-line 24 from the high-pressure line to the flare, a side-line 24b is arranged, with a choke 23b which is connected to the low-pressure line 27. This solution is simple and functionally safe and the choke opening 23b can be chosen according to the capacity of the flare 25.

Figure 2c shows an embodiment where two side-lines 24b, 24c are used, which side-lines 24b, 24c are parallel to each other, between the high-pressure and low-pressure lines 22, 27, a side-line 24b with choke 23b corresponding to fig. 2b, and a side-line 24c which is, in addition to a choke 23c, equipped with a valve 29, preferably a time-regulated valve. During depressurization the valve 29 will open after a certain time, and the amount of gas from the high-pressure line 22 to the flare 25 will increase. The load of the low-pressure line 27 will at this point of time have decreased, thus making opening of the valve 29 possible.

The actual underwater gas-release system can be designed in many different ways. Fig. 3 shows a preferred embodiment of a "double pressure-relief system" on a platform 10. The pressure-relief system comprises a header system 31 from each pressure-relief group. The collective pipe system 31 is extended down to the sea-bed for discharge via an underwater gas-release system 13. In addition, the header system 31 is connected with a side pipe 33

which leads along a boom 34 to a conventional flare 25. The side pipe 33 comprises a choke or valve for regulating the flow of gas.

The flow through the choke will be a function of the upstream pressure from the system and the opening of the choke. If a valve is used, it can be time-regulated. In the figure, only one header system is indicated on the deck. Some equipment, for example some types of compressor, are sensitive to back pressure in the header system 31, and in practice, a separate pressure-relief loop connected directly to a conventional flare would be required for such equipment. It must however, be pointed out that the amount of gas which has to be pressure-relieved with such equipment is relatively small.

The underwater gas-release system 13, which is a collective term for the pressure-relief system which comprises the extension from the header system 31 and down to the discharge site or sites, extends in the upper part inside the shaft of the platform 10 and through the wall of the shaft and further down the outside of the platform's shaft at considerable distance from the surface of the sea.

Instead of directing the gas out at a point on the sea-bed, it will be possible, as suggested in fig. 3, to let the pipeline extend parallel to the sea-bed and to provide the pipeline with several orifices 35.

In this way it will be possible to achieve a dispersion of gas over a considerable area, which will make this concept more feasible in areas where the water is not too deep.

As mentioned previously, the gas from the various pressure-relief groups is, in a conventional system, collected with a header system which ends up in a knock-out drum and a flare 25. The requirements today are that most sources can be pressure-relieved

to about 7 bars within a certain period of time. In the case of discharge under water, the equipment will be depressurized to the static pressure which prevails at the site of discharge and further pressure-relief will take place through a conventional flare with a reduced boom length. It is desirable to relieve as much of the gas as possible under water, so that the length of the flare boom can be as short as possible. In order to achieve this it is suggested in an embodiment according to the invention that the gas-release system under water is provided with several points of discharge located at various depths. Figures 4 a-e show schematically several constructive embodiments of such a system, and each embodiment will be more closely described in the following.

Fig. 4a shows a platform 10 which is founded on the sea-bed 11 and comprises a schematically shown underwater gas-release system which comprises three points of discharge 45a, 45b, 45c, at three different levels. In order to prevent, to the greatest possible extent, the gas from rising up to the surface 12 close to the platform 40, it is suggested that the discharge points of the gas 45a, 45b, 45c are situated at a horizontal distance from the platform 10. The underwater line 13, which is secured to, and extends downwards alongside the platform shaft, is produced preferably of rigid corrosion-resistant material, for example steel. Flexible hoses, 48a, 48b, 48c which lead out to the points of discharge 45a, 45b, 45c, are attached to the line 13. It is suggested that the hose-ends are attached to a chain arrangement 49 which at it's lower end is secured to the sea-bed 11, while it's upper end is secured to a buoyancy element 50. The arrangement is kept secure by way of guy ropes 51 secured to the seabed 11 and possibly to the platform 10. The flexible hoses 48a, 48b, 48c must be secured and can optionally be equipped with buoyancy elements 52, so that they always slope downwards towards the points of discharge 45a, 45b 45c in order to avoid liquid build-up of heavier hydrocarbons in the hoses 48a, 48b, 48c.

Fig. 4b shows in principle the same concept as fig. 4a except that the end-part of the hoses 48a, 48b, 48c are attached to a rigid underwater buoy 53, for example of concrete which by way of a joint 54 is secured to the sea-bed 11. This construction will relatively easily be able to absorb reactive forces from the various outlets in the case of pressure-relief.

Fig. 4c shows a construction, where the points of discharge is situated on a corresponding type of underwater buoy 53 which in a similar manner is secured by way of a flexible joint 54 to the sea-bed 11. The actual underwater main pipe or line consists however, of three separate pipes 55 which extend downwards alongside the shaft of the platform to the sea-bed 41 and via flexible hoses on the sea-bed 41 and via flexible hoses on the sea-bed 41 and upwards alongside the underwater buoy 53 to their respective points of discharge. The most important advantage of such a concept will be that, as opposed to the solutions in fig. 4a-b, there are no hoses or pipes floating freely at various depths between the platform and the underwater anchoring arrangement. A disadvantage with the concept will be the danger of liquid build-up of heavier hydrocarbons in the flexible pipes which extend along the sea bed.

Fig. 4d shows a conceptual design where rigid pipes 58a, 58b, 58c extend from the line 13 alongside the platform shaft 47 out to the respective points of discharge. The pipes are supported by frame-work structures 57a, 57b, 57c which in the shown embodiment are in the shape of triangular towers. Each corner can for instance consist of pipes where one of the pipes can be a gas discharge pipe. Alternatively, the lower point of discharge 59a can be mounted onto a smaller framework tower on the sea bed 11. The framework structures are spread around the platform 40 in order to spread the loads. An advantageous characteristic of this embodiment is that the system is independent of movements between the platform 40 and the sea bed 41.

Fig. 4e shows a corresponding embodiment with rigid pipes 58a, 58b, 58c, as in fig. 4d, but where the points of discharge are supported by a framework tower 60 which rests on the sea bed 11, and where framework bridges 61 are stretched between the tower 60 and the platform 40 to support the pipes.

A method for depressurization of process equipment on platforms off-shore according to the invention can comprise the following steps:

- gas is collected in a manner known in the art, from the various pressure-relief groups, where gas from low-pressure equipment and back-pressure sensitive equipment is conducted directly to a conventional system with liquid separator and flare,

- high-pressure gas is relieved through an underwater gas-release system to a predetermined level, after which further relieval takes place through a choke or a valve which opens in a side-line for pressure-relief in a conventional system.

PATENT CLAIMS

1. Method for depressurization of a production process on a platform (10) offshore characterized in that gas, in the case of pressure-relief of the production process, is wholly or partly led to discharge under water.

2. Method according to claim 1, characterized in that the gas is led to discharge via an underwater gas-release system, or several points at considerable distance beneath the surface of the sea.

3. Method according to claim 1, characterized in that the whole or part of the production process, are pressure relieved via the underwater gas-release system to a level of pressure substantially equal to the static pressure at the point or points of discharge, after which the production process is further relieved of pressure through a conventional system with liquid separator and flare (25).

4. Method according to claim 1 and 3, characterized in that high-pressure sources in the production process are depressurized via the underwater gas-release system, where gas from low-pressure sources and gas with a pressure level below the static pressure at the point or points of discharge of the underwater gas-release system is depressurized through a conventional system with liquid separator and flare.

5. Device for a depressurization system for a production process on a platform (10) offshore, characterized in that it comprises an underwater gas-release system through which at least some of the gas, at depressurization, is led to discharge under water.

6. Device according to claim 1 c h a r a c t e r i z e d in that the underwater gas-release system comprises at least one pipe (32, 13, 55) which extends from one or more header systems on the platform (10), and is conducted down into the sea alongside the shaft (47) of the platform and terminates at at least one point of discharge under water.

7. Device according to claims 1 and 2, c h a r a c t e r i z e d in that the underwater gas-release system ends in several points of discharge (35) located in deep water and substantially parallel in relation to the surface of the sea.

8. Device according to one or more of the previous claims, c h a r a c t e r i z e d in that the underwater gas-release system ends up at several points of discharge (45a-c, 59a-c) located at various depths beneath the surface of the sea.

9. Device according to claims 1-4, c h a r a c t e r i z e d in that the points of discharge are located at a horizontal minimum distance from the platform (10).

10. Device according to claim 1, c h a r a c t e r i z e d in that the upper part of the pipe of the gas-release system, which extends from the header system (31) extends inside the shaft (47) of the platform (10), whilst the lower part of the pipe, below the splashing zone, is attached to the outer side of the shaft.

11. Device according to claim 6, c h a r a c t e r i z e d in that the platform's header system (31) comprises a header line (22) from high-pressure sources which are led to discharge under water, a header line (27) from low-pressure sources which depressurize gas via a conventional flare (25), where at least one sideline (24) is arranged, which connects the high-pressure and low-pressure header lines (22, 27).

12. Device according to claim 11, c h a r a c t e r i z e d in that the header system (31) comprises a sideline (24b) with a choke opening (23b) to connect the high-pressure and low-pressure header lines (22, 27).

13. Device according to claims 11 and 12, c h a r a c t e r i z e d in that it parallel to the sideline (24c), comprises a choke (23c) and a valve (29) which is preferably time-regulated.

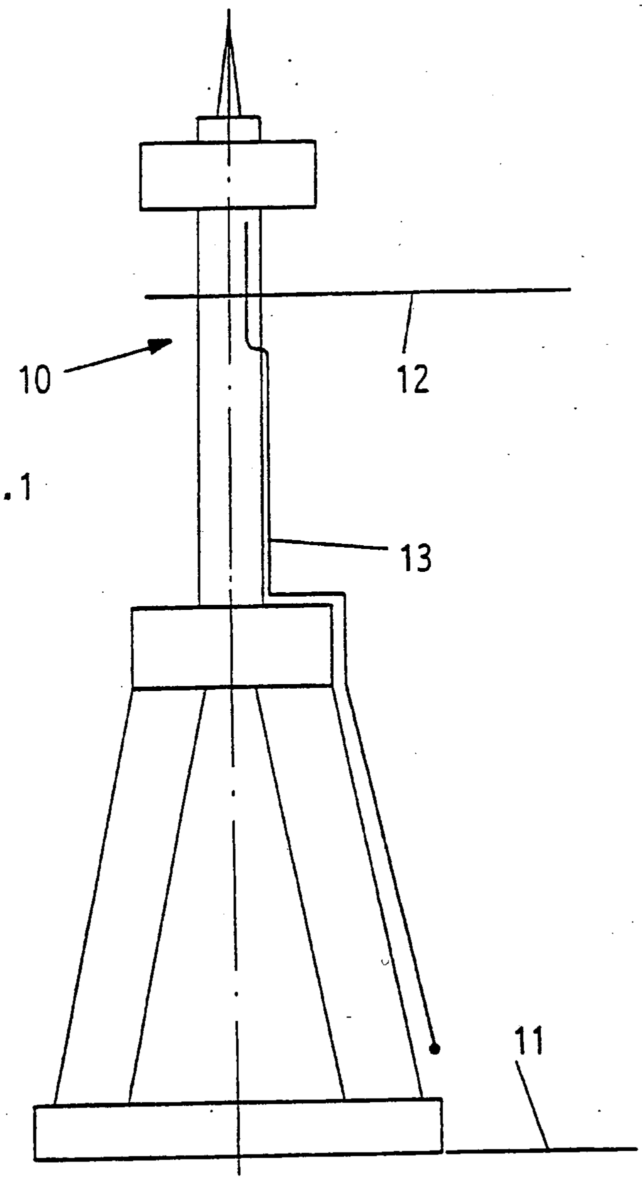


FIG.1

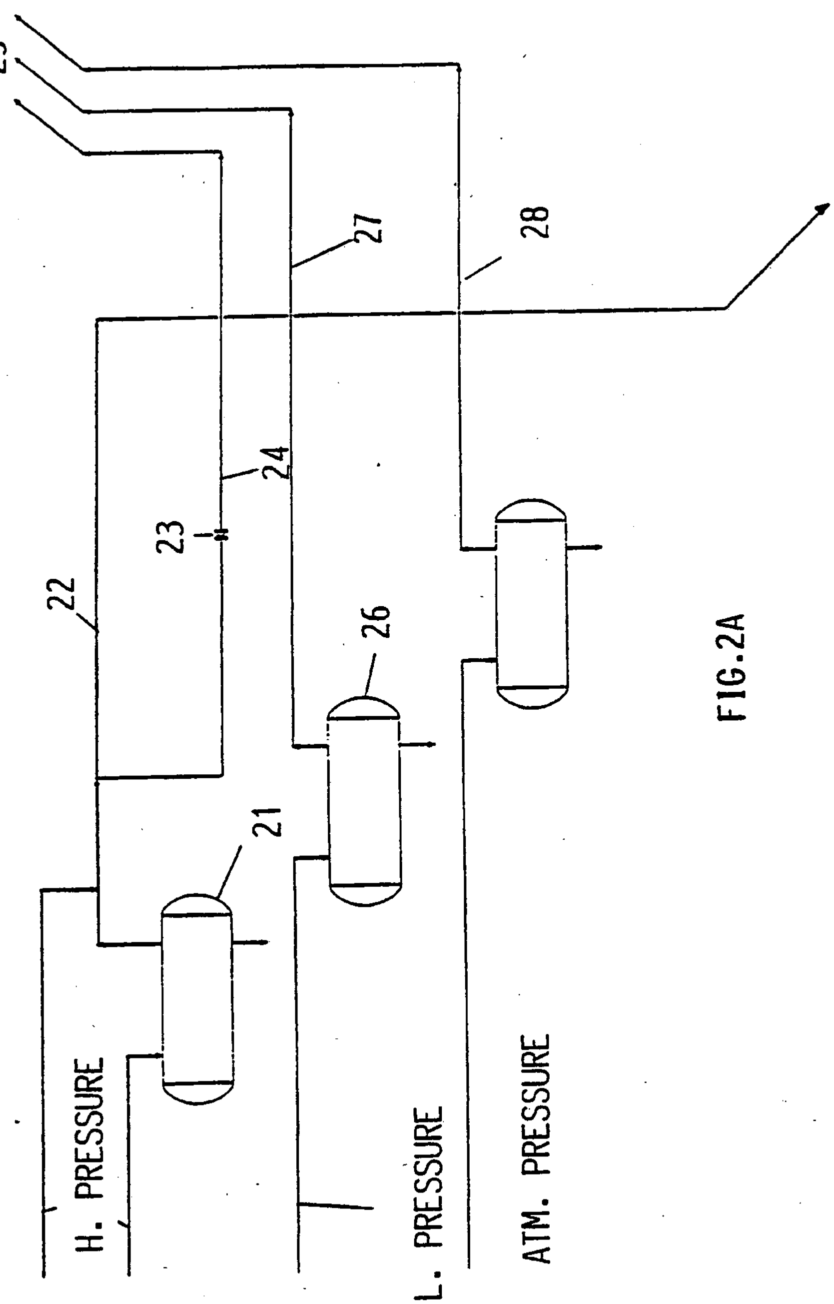


FIG.2A

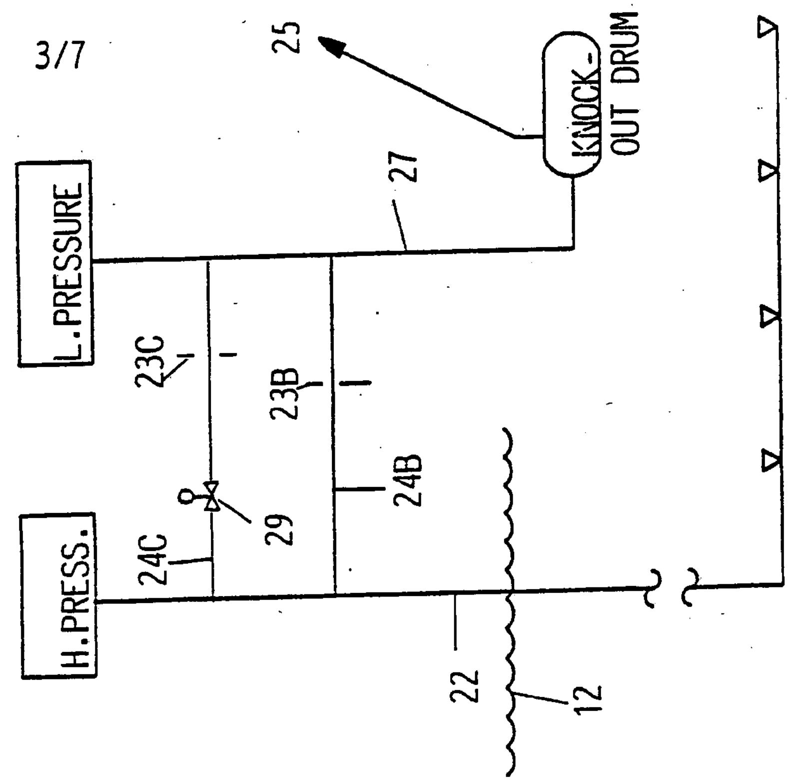

L.PRESSURE
H.PRESS.
KNOCK-
OUT DRUM
25
27
23C
23B
24B
24C
29
22
12

FIG.2C

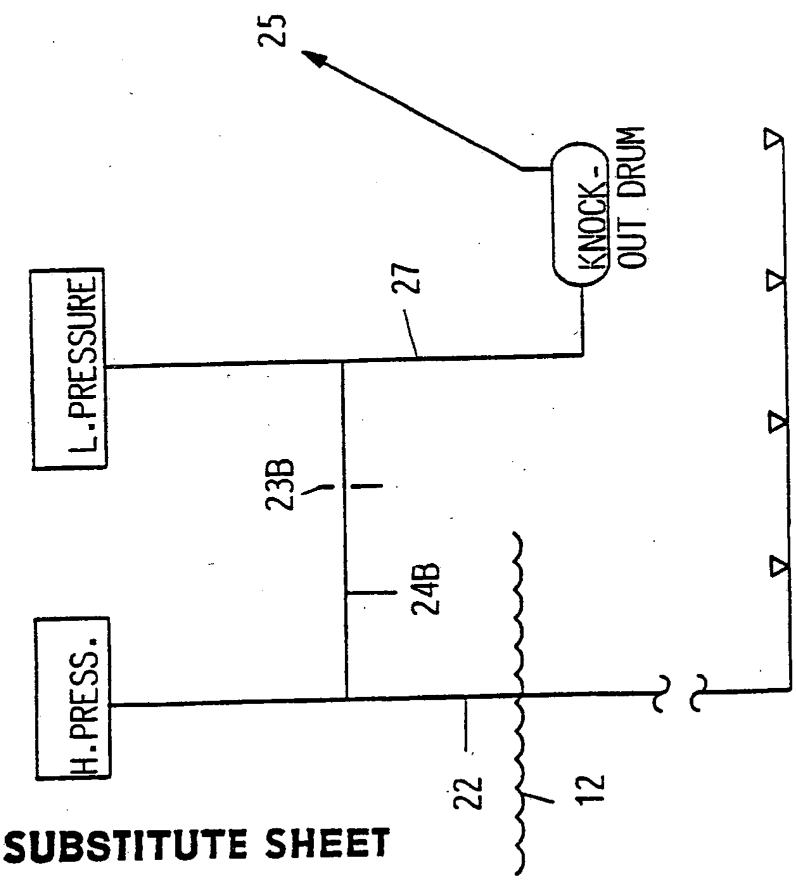

L.PRESSURE
H.PRESS.
KNOCK-
OUT DRUM
25
27
23B
24B
22
12

FIG.2B

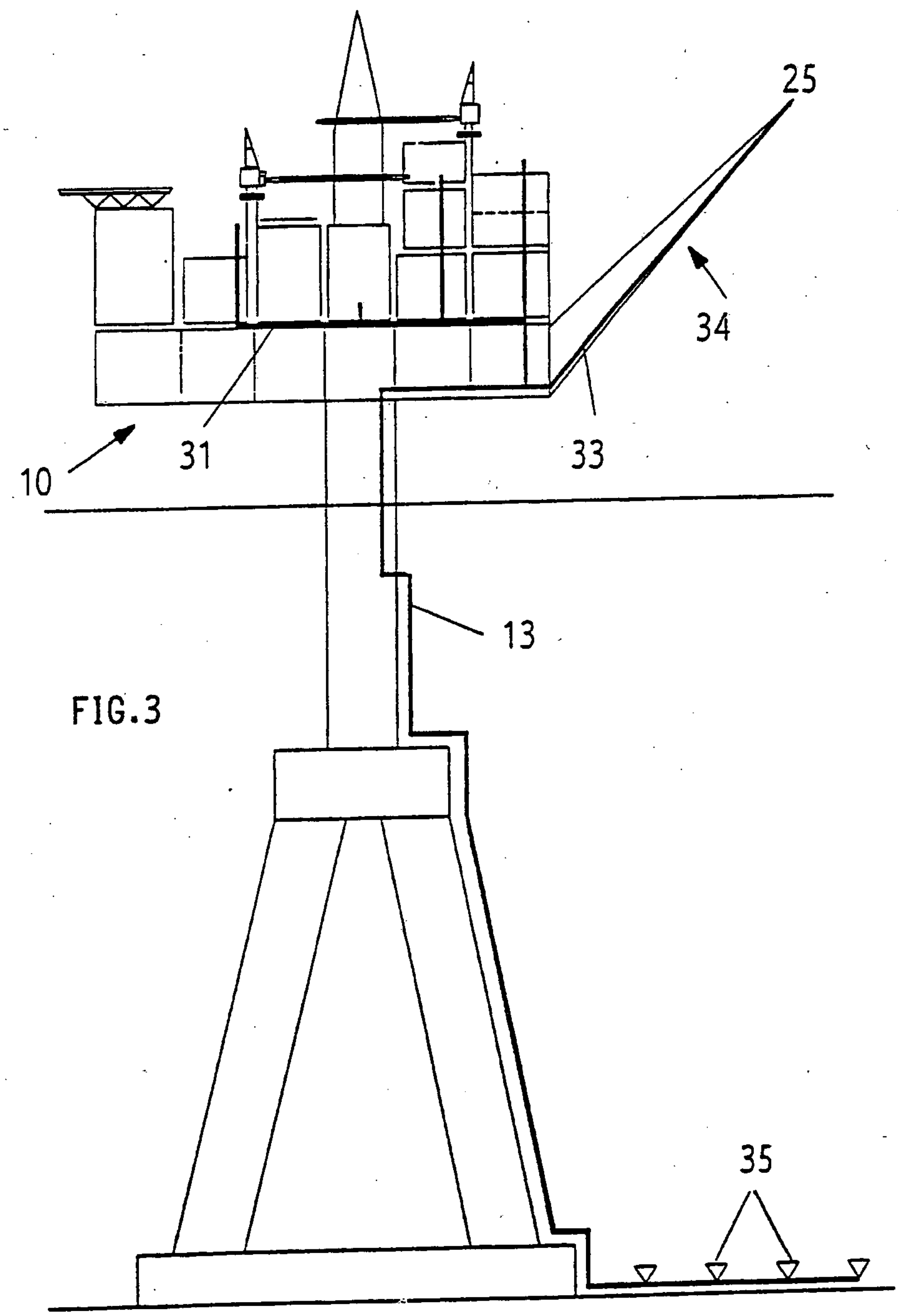


FIG.3

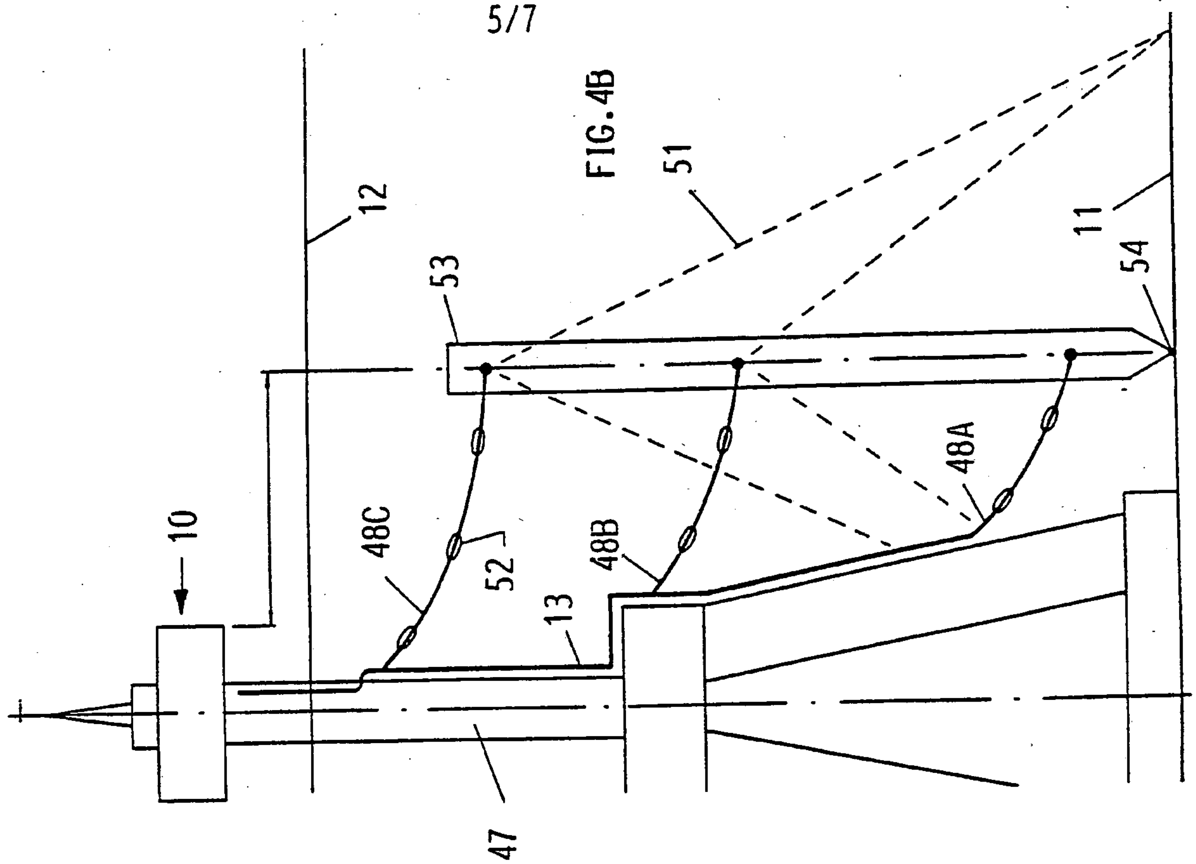
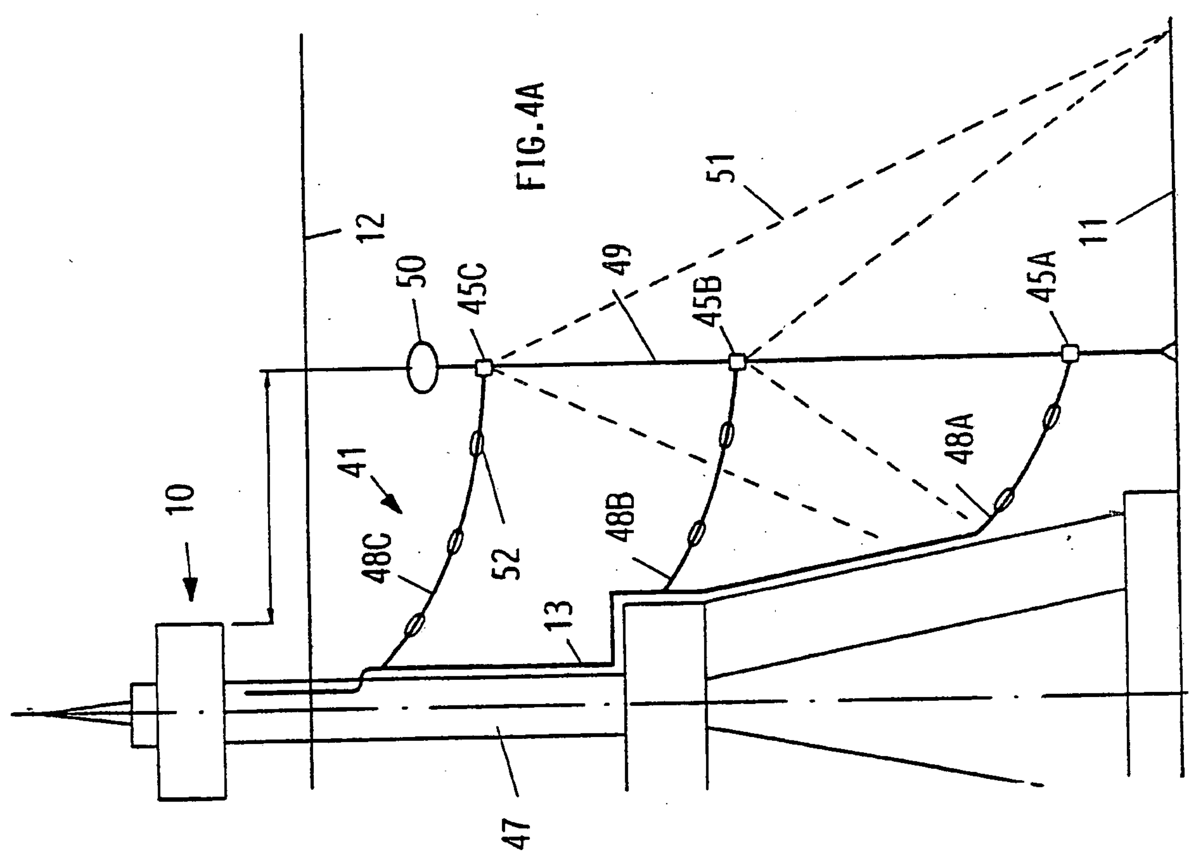

10
12
53
51
11
54
48C
52
48B
13
48A
47

FIG.4B


10
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45C
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45B
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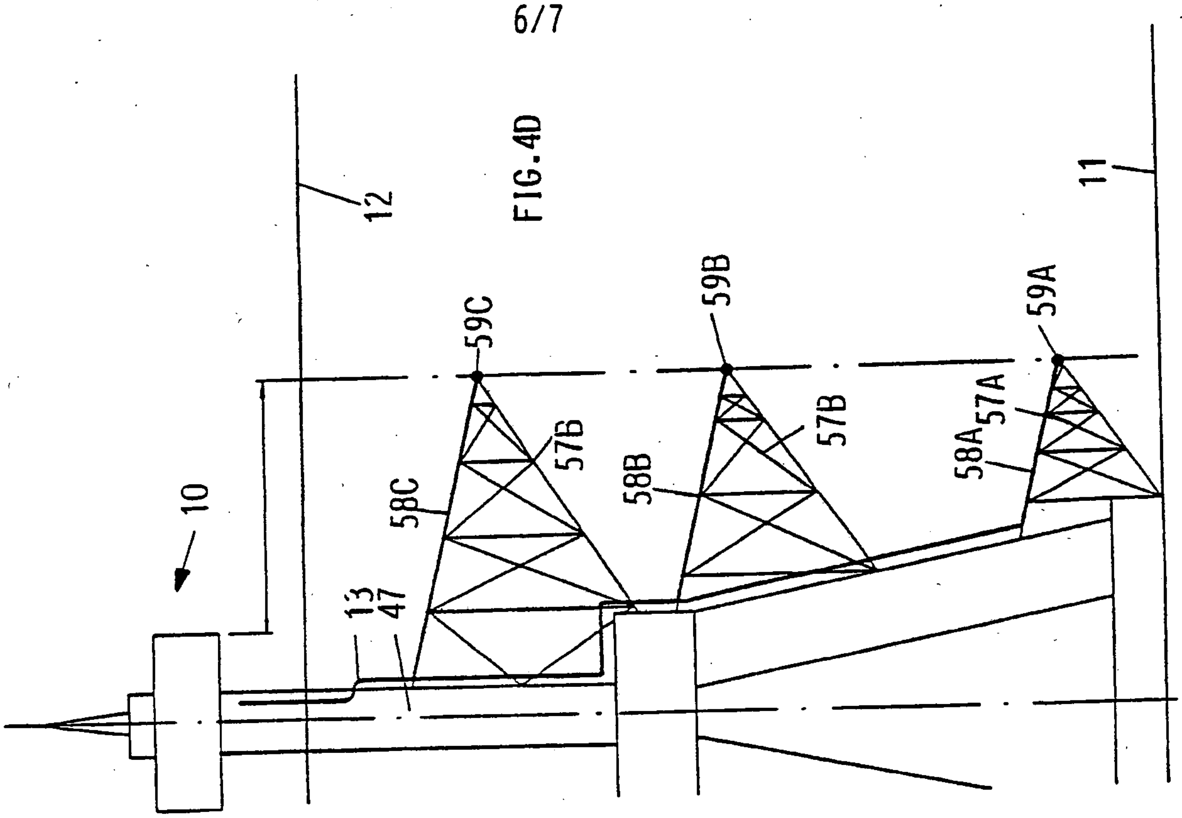
45A
11
41
48C
52
48B
13
48A
47

FIG.4A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12
13
47
58C
57B
59C
58B
57B
59B
58A
57A
59A
11

FIG.4D

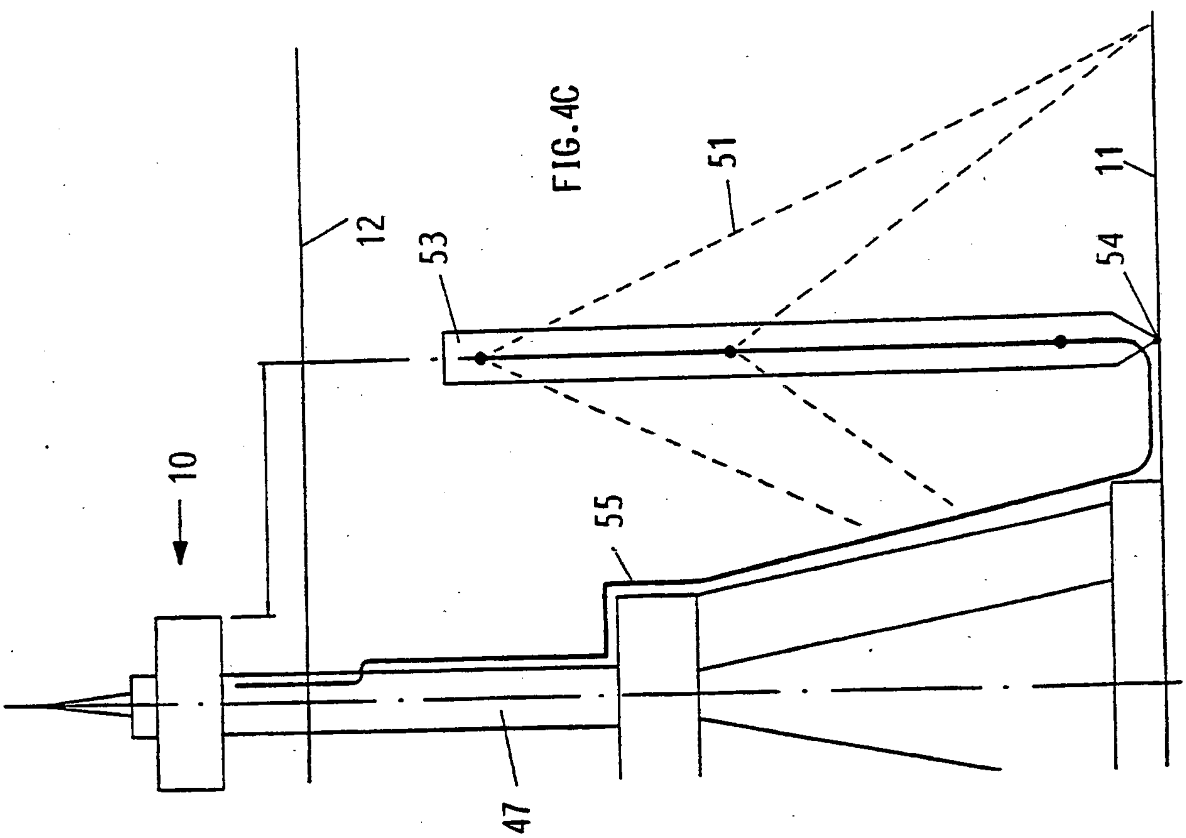
10
47
12
55
53
51
54
11

FIG.4C

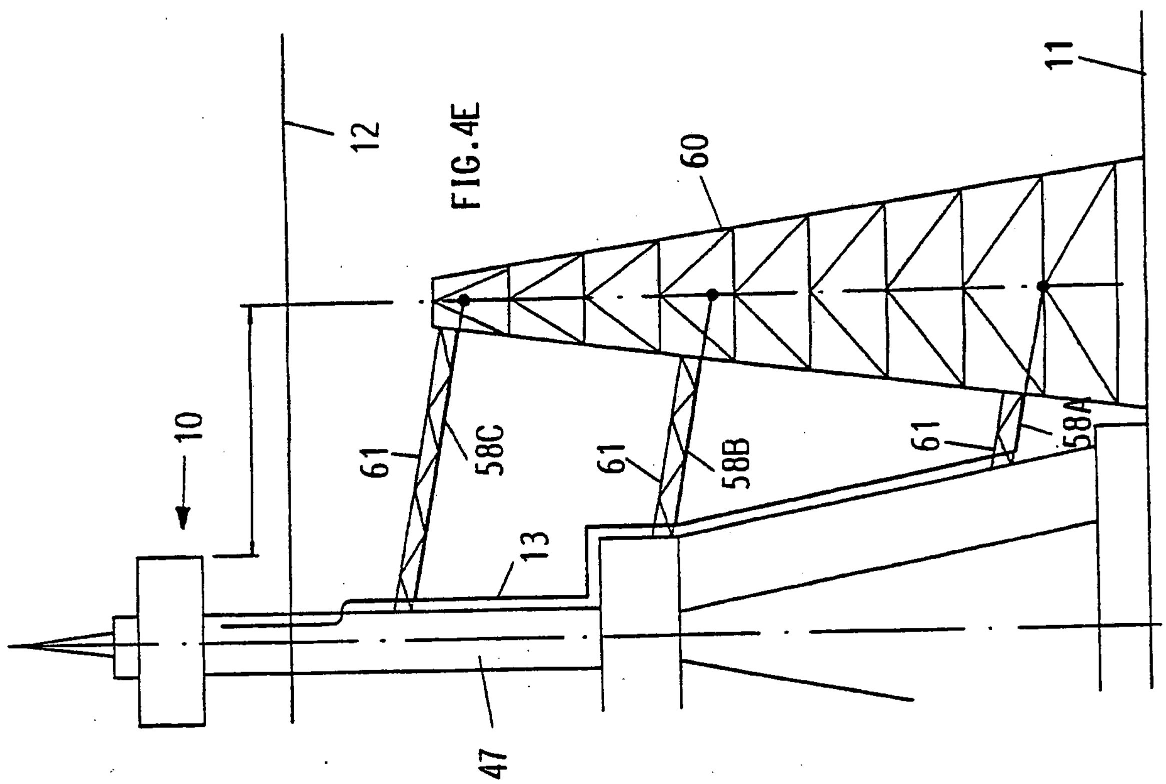

FIG. 4E

INTERNATIONAL SEARCH REPORT

International Application No PCY/NO88/00016

I. CLASSIFICATI N OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

E 21 B 43/00, 43/34

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	E 21 B 43/00, /01, /34, /36
US Cl	166: 265-267

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	DE, A1, 2 253 116 (ENTREPRISE DE RECHERCHES ET D'ACTIVITES PETROLIERES-ELF) 3 May 1973	
A	EP, A1, 0 096 636 (CHAUDOT GÉRARD) 21 December 1983	
A	WO, A1, 87/01759 (STIFTELSEN FOR INDUSTRIELL OG TEKNISK FORSKNING VED NORGES TEKNISKE HÖGSKOLE) 26 March 1987	
A	US, A, 3 556 218 (WILLIAM A TALLEY JR) 19 January 1971	

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1988-05-05	1988 -05- 05
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